

COPY

IN THE CLAIMS

Please amend the claims of the above-identified application so as to read as follows:

1. (Currently Amended) An active-matrix image display device which includes a power supply of a charge-pump system, and drivers which come into operation in response to a supply of power from the power supply to drive display cells, said drivers having two operational modes including a scanning mode during which said active matrix display is vertically scanned and in which said power supply operates at a first frequency and a video signal is applied to any of the display cells, and a hold mode in which said power supply operates at a second non-zero frequency smaller than said first frequency and no video signal is applied to any of the display cells, said active-matrix image display device comprising:
mode switching means for periodically changing the operational modes so that a duration of the hold mode is equal to or longer than a duration of the scanning mode; and
control means for switching, according to the operational modes, the frequency at which pump operation of the power supply is activated.
2. (Previously Presented) The active-matrix image display device as set forth in claim 1, wherein:
a maximum of the operating current value in the scanning mode of the drivers and an operating current value in the hold mode of the drivers differ by 10 times or more,
said frequency at which pump operation of the power supply is activated by said control means is established according to said maximum value of the operating current values of the drivers, and
said power supply is configured so as to provide high conversion efficiency at said frequency.

COPY

3. (Original) The active-matrix image display device as set forth in claim 1, wherein said power supply includes a first oscillator which generates a first clock signal which is used as a reference in the pump operation of the power supply in the scanning mode.
4. (Original) The active-matrix image display device as set forth in claim 3, wherein said power supply includes a divider which divides the first clock signal to generate a second clock signal which is used as a reference in the pump operation of the power supply in the hold mode.
5. (Original) The active-matrix image display device as set forth in claim 3, wherein said power supply includes an input terminal for inputting a second clock signal which is used as a reference in the pump operation of the power supply in the hold mode, and oscillator control means for inactivating operation of the first oscillator during at least a part of a period of the pump operation operated by the second clock signal.
6. (Original) The active-matrix image display device as set forth in claim 3, wherein said power supply includes a second oscillator which generates a second clock signal which is used in the pump operation of the power supply in the hold mode, and oscillator control means for inactivating operation of the first oscillator during at least a period of the pump operation operated by the second clock signal.
7. (Original) The active-matrix image display device as set forth in claim 1, wherein:
the scanning mode and the hold mode are repeated periodically with a period of several hundred msec.

COPY

8. (Original) The active-matrix image display device as set forth in claim 1, wherein:
a period of the hold mode is set to be several times to several ten times longer than a period of the scanning mode.
9. (Previously Presented) The active-matrix image display device as set forth in claim 1, wherein
said control means makes up said mode switching means, and, when increasing frequency, switches the frequency in advance a predetermined time interval before switching of the operation modes, so that the increase of frequency is finished by the time the switching of the operational modes is started.
10. (Original) The active-matrix image display device as set forth in claim 1, wherein:
among power consumption of an image display section including the display cells and drivers, power consumption in the hold mode is lower than power consumption of the control means and the power supply itself in the scanning mode.
11. (Original) The active-matrix image display device as set forth in claim 1, comprising:
a first power supply for multiplying an input voltage by a predetermined constant factor;
a regulator for generating a first voltage by stabilizing an output voltage of the first power supply to a predetermined value, and supplying the first voltage to the drivers;
and
a second power supply for generating a second voltage by multiplying the first voltage by a predetermined constant factor, and supplying the second voltage as an ON voltage or an OFF voltage to a scanning signal line driver, which is one of the drivers,
wherein at least one of the first power supply and the second power supply makes up the power supply under control of the control means.

COPY

12. (Previously Presented) The active-matrix image display device as set forth in claim 1, comprising:

- a first power supply for raising an input voltage by a predetermined factor;
 - a regulator for generating a first voltage by stabilizing an output voltage of the first power supply to a predetermined value, and supplying the first voltage to the drivers;
 - a second power supply for raising the first voltage by a predetermined factor, and supplying the resulting voltage as an ON voltage of a scanning signal line driver, which is one of the drivers; and
 - a third power supply for inverting and raising the first voltage by a predetermined factor, and supplying the resulting voltage as an OFF voltage to the scanning signal line driver, which is one of the drivers,
- wherein at least one of the first power supply, the second power supply, and the third power supply makes up the power supply under control of the control means.

13. (Currently Amended) Portable electrical equipment with an image display device, said image display device being an active-matrix image display device which includes a power supply of a charge-pump system, and drivers which come into operation in response to a supply of power from the power supply to drive display cells, said drivers having two operational modes including a scanning mode during which said active matrix display is vertically scanned and in which said power supply operates at a first frequency and a video signal is applied to any of the display cells, and a hold mode in which said power supply operates at a second non-zero frequency smaller than said first frequency and no video signal is applied to any of the display cells; said image display device comprising:

mode switching means for periodically changing the operational modes so that a duration of the hold mode is equal to or longer than a duration of the scanning mode; and

control means for switching, according to the operational modes, the frequency at which pump operation of the power supply is activated.

COPY

14. (Currently Amended) An active-matrix image display device which includes a power supply of a charge-pump system, and drivers which come into operation in response to a supply of power from the power supply to drive display cells, said drivers having two operational modes including a scanning mode during which said active matrix display is vertically scanned and in which a video signal is applied to any of the display cells, and a hold mode in which no video signal is applied to any of the display cells, said power supply maintaining an output voltage value while said drivers are in said hold mode by a smoothing capacitor which is located between an input to said drivers and an output of the power supply, said power supply including:

control means for stopping the pump operation of the power supply while said drivers are in said hold mode, and

mode switching means for periodically changing the operational modes so that a duration of the hold mode is equal to or longer than a duration of the scanning mode.

15. (Original) The active-matrix image display device as set forth in claim 14, wherein the scanning mode and the hold mode are periodically repeated with a period of several hundred msec.

16. (Previously Presented) The active-matrix image display device as set forth in claim 14, wherein said mode switching means periodically switches the operational modes so that the duration of the hold mode becomes equal to or longer than the duration of the scanning mode, and

any decrease in the output voltage value of the power supply present when pump operation is resumed at the time of a switch from the hold mode to the scanning mode is not more than 10% of an output voltage value to be maintained.

17. (Previously Presented) The active-matrix image display device as set forth in claim 14, wherein said mode switching means switches the operational modes so that a duration of the hold mode becomes equal to or longer than a duration of the scanning mode, and a recovery time required for an output voltage value which dropped while the pump operation was inactive to return to the output voltage value to be maintained from resumption of the pump operation is within several ten msec, and the scanning mode and the hold mode are periodically repeated with a period of several hundred msec.

18. (Previously Presented) The active-matrix image display device as set forth in claim 14, wherein:
an operating current value in the hold mode of the drivers is not more than 0.01 times an operating current value in the scanning mode, and
said mode switching means switches the operational modes so that a duration of the hold mode becomes equal to or longer than a duration of the scanning mode, and the scanning mode and the hold mode are periodically repeated with a period of several hundred msec.

19. (Original) The active-matrix image display device as set forth in claim 14, wherein a period of the hold mode is set to be several times to several ten times longer than a period of the scanning mode.

20. (Previously Presented) The active-matrix image display device as set forth in claim 14, wherein said control means makes up said mode switching means, and, when resuming pump operation, resumes the pump operation in advance of a predetermined time interval before switching of the operational modes, so that resumption of pump operation is finished by the time the switching of the operational modes is started.

COPY

21. (Original) The active-matrix image display device as set forth in claim 14, wherein:

among power consumption of an image display section including the display cells and the drivers, power consumption in the hold mode is lower than power consumption of the control means and power supply itself in the scanning mode.

22. (Previously Presented) The active-matrix image display device as set forth in claim 14, comprising:

a first power supply for multiplying an input voltage by a predetermined constant factor;
a regulator for generating a first voltage by stabilizing an output voltage of the first power supply to a predetermined value, and supplying the resulting voltage to the drivers; and

a second power supply for generating a second voltage by multiplying the first voltage by a predetermined constant factor, and supplying the resulting voltage as an ON voltage or an OFF voltage to a scanning signal line driver, which is one of the drivers,

wherein at least one of the first power supply and the second power supply makes up the power supply under the control of the control means.

23. (Previously Presented) The active-matrix image display device as set forth in claim 14, comprising:

a first power supply for raising an input voltage by a predetermined factor;
a regulator for generating a first voltage by stabilizing an output voltage of the first power supply to a predetermined value, and supplying the first voltage to the drivers;
a second power supply for raising the first voltage by a predetermined factor, and supplying the resulting voltage as an ON voltage to a scanning signal line driver, which is one of the drivers; and

COPY

a third power supply for inverting and raising the first voltage by a predetermined factor, and supplying the resulting voltage as an OFF voltage to the scanning signal line driver, which is one of the drivers, wherein at least one of the first power supply, the second power supply, and the third power supply makes up the power supply under control of the control means.

24. (Currently Amended) Portable electrical equipment with an image display device, said image display device being an active-matrix image display device which includes a power supply of a charge-pump system, and drivers which come into operation in response to a supply of power from the power supply to drive display cells, said drivers having two operational modes including a scanning mode during which said active matrix display is vertically scanned and in which a video signal is applied to any of the display cells, and a hold mode in which no video signal is applied to any of the display cells, said power supply maintaining an output voltage value while said drivers are in said hold mode by a smoothing capacitor which is located between an input to said drivers and an output of the power supply while the pump operation is inactive, said image display device comprising:

control means for stopping the pump operation of the power supply while said drivers are in said hold mode, and

mode switching means for periodically changing the operational modes so that a duration of the hold mode is equal to or longer than a duration of the scanning mode.

25. (Previously Presented) An active-matrix image display device as set forth in claim 1, wherein, when power consumption is to be reduced, said drivers increase a vertical scanning period of said display so as to be longer than a normal vertical scanning period of said device.

COPY

26. (Previously Presented) An active-matrix image display device as set forth in claim 13, wherein, when power consumption is to be reduced, said drivers increase a vertical scanning period of said display so as to be longer than a normal vertical scanning period of said device.
27. (Previously Presented) An active-matrix image display device as set forth in claim 14, wherein, when power consumption is to be reduced, said drivers increase a vertical scanning period of said display so as to be longer than a normal vertical scanning period of said device.
28. (Previously Presented) An active-matrix image display device as set forth in claim 24, wherein, when power consumption is to be reduced, said drivers increase a vertical scanning period of said display so as to be longer than a normal vertical scanning period of said device.
29. (Previously Presented) An active-matrix image display device as set forth in claim 1, wherein, when power consumption is to be reduced, said drivers insert a hold mode in the scanning mode that is an operational mode under normal driving conditions of said device so as to increase a vertical scanning period of said display so as to be longer than a normal vertical scanning period of said device.
30. (Previously Presented) An active-matrix image display device as set forth in claim 13, wherein, when power consumption is to be reduced, said drivers insert a hold mode in the scanning mode that is an operational mode under normal driving conditions of said device so as to increase a vertical scanning period of said display so as to be longer than a normal vertical scanning period of said device.

COPY

31. (Previously Presented) An active-matrix image display device as set forth in claim 14,
wherein, when power consumption is to be reduced, said drivers insert a hold
mode in the scanning mode that is an operational mode under normal driving
conditions of said device so as to increase a vertical scanning period of said
display so as to be longer than a normal vertical scanning period of said device.

32. (Previously Presented) An active-matrix image display device as set forth in claim 24,
wherein, when power consumption is to be reduced, said drivers insert a hold
mode in the scanning mode that is an operational mode under normal driving
conditions of said device so as to increase a vertical scanning period of said
display so as to be longer than a normal vertical scanning period of said device.

33. (Previously Presented) The active-matrix image display device as set forth in claim 1,
wherein:

a maximum of the operating current value in the scanning mode of the drivers and an
operating current value in the hold mode of the drivers differ by 10 times or
more,

said frequency at which pump operation of the power supply is activated by said control
means is established according to said maximum value of the operating current
values of the drivers, and

the maximum values of the operating current values and the frequency at that maximum
value determine a capacitance of a capacitor and a capacitance of a smoothing
capacitor for pump operation, and also determine the configuration of a switching
element for switching said capacitor for pump operation, and

said frequency at said maximum value determines a capacitance and a resistance of a CR
oscillator that constitutes a clock generator for generating a clock signal to be fed
to the switching element.

COPY

34. (Previously Presented) The image display device of claim 1, wherein a non-scanning voltage is output to all scanning signal lines in the hold mode, so as to maintain display by means of electric charge stored in a pixel electrode or an auxiliary capacitor of each pixel.
35. (Previously Presented) The image display device of claim 34, wherein an auxiliary capacitor electrode pad and a auxiliary capacitor wire as the auxiliary capacitor are provided on a position where substantially no capacitive coupling with the scanning signal line occurs.
36. (Previously Presented) The image display device of claim 35, wherein a part of the auxiliary capacitor wire is paired with the auxiliary capacitor electrode pad with a gate insulating film therebetween, avoiding the scanning signal line.
37. (Previously Presented) The image display device of claim 36, wherein the auxiliary capacitor wire is provided parallel to the scanning signal line.
38. (Previously Presented) The image display device of claim 13, wherein a non-scanning voltage is output to all scanning signal lines in the hold mode, so as to maintain display by means of electric charge stored in a pixel electrode or an auxiliary capacitor of each pixel.

COPY

39. (Previously Presented) The image display device of claim 38, wherein an auxiliary capacitor electrode pad and a auxiliary capacitor wire as the auxiliary capacitor are provided on a position where substantially no capacitive coupling with the scanning signal line occurs.
40. (Previously Presented) The image display device of claim 39, wherein a part of the auxiliary capacitor wire is paired with the auxiliary capacitor electrode pad with a gate insulating film therebetween, avoiding the scanning signal line.
41. (Previously Presented) The image display device of claim 40, wherein the auxiliary capacitor wire is provided parallel to the scanning signal line.
42. (Previously Presented) The image display device of claim 14, wherein a non-scanning voltage is output to all scanning signal lines in the hold mode, so as to maintain display by means of electric charge stored in a pixel electrode or an auxiliary capacitor of each pixel.
43. (Previously Presented) The image display device of claim 42, wherein an auxiliary capacitor electrode pad and a auxiliary capacitor wire as the auxiliary capacitor are provided on a position where substantially no capacitive coupling with the scanning signal line occurs.
44. (Previously Presented) The image display device of claim 43, wherein a part of the auxiliary capacitor wire is paired with the auxiliary capacitor electrode pad with a gate insulating film therebetween, avoiding the scanning signal line.

COPY

45. (Previously Presented) The image display device of claim 44, wherein the auxiliary capacitor wire is provided parallel to the scanning signal line.

46. (Previously Presented) The image display device of claim 24, wherein a non-scanning voltage is output to all scanning signal lines in the hold mode, so as to maintain display by means of electric charge stored in a pixel electrode or an auxiliary capacitor of each pixel.

47. (Previously Presented) The image display device of claim 46, wherein an auxiliary capacitor electrode pad and a auxiliary capacitor wire as the auxiliary capacitor are provided on a position where substantially no capacitive coupling with the scanning signal line occurs.

48. (Previously Presented) The image display device of claim 47, wherein a part of the auxiliary capacitor wire is paired with the auxiliary capacitor electrode pad with a gate insulating film therebetween, avoiding the scanning signal line.

49. (Previously Presented) The image display device of claim 48, wherein the auxiliary capacitor wire is provided parallel to the scanning signal line.